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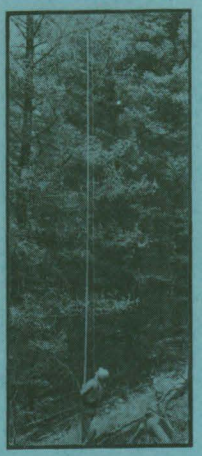
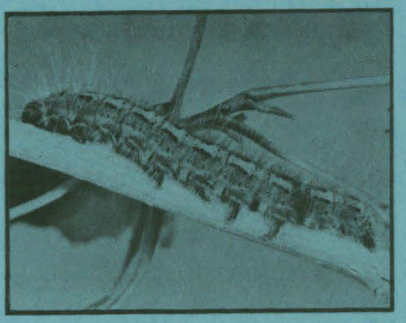
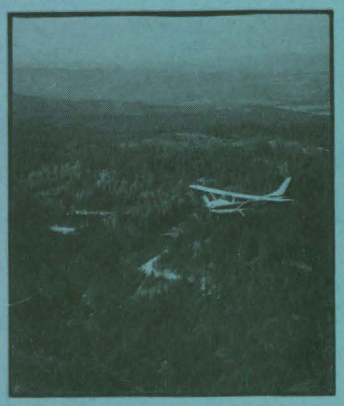
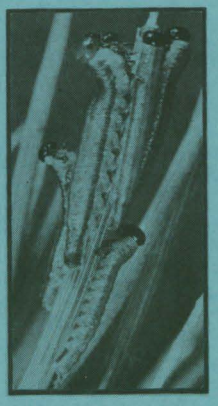
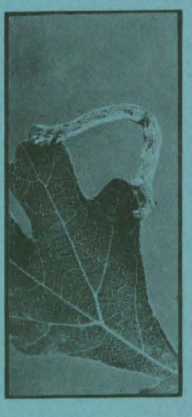


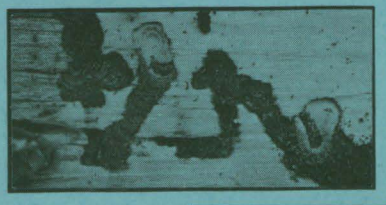


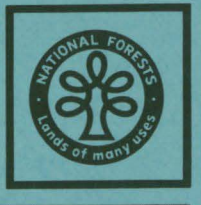
FOREST INSECT and DISEASE CONDITIONS in the Intermountain States 1971











Branch of Forest Insect and Disease Prevention and Control
Division of Timber Management
Region 4 Forest Service
U.S. Department of Agriculture
Ogden, Utah

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Entomology

Douglas L. Parker - Bark Beetles
Lawrence E. Stipe - Defoliators

Pathology

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FOREST INSECT and DISEASE CONDITIONS in the Intermountain States 1971

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RESUMÉ OF CONDITIONS

ENTOMOLOGY

The mountain pine beetle was the most important forest insect pest in the Intermountain Region in 1971. The massive infestations in lodgepole pine in Idaho and Wyoming subsided, except in isolated portions of the Targhee and Teton National Forests and in Grand Teton National Park. On the Targhee National Forest, a large buildup occurred in the Warm River area following termination of the chemical control program. An increase in tree killing also occurred at the northern end of Grand Teton National Park and the adjoining Teton National Forest. Elsewhere in the Region, population decreases occurred in the lodgepole pine forests. In ponderosa pine, scattered outbreaks of the mountain pine beetle continued on the Dixie National Forest and in neighboring Bryce Canyon National Park in southern Utah and on the Ashley National Forest in northern Utah. Extensive tree killing of limber and whitebark pines was detected in Idaho and Wyoming during the 1971 aerial survey.

Douglas-fir beetle outbreaks on the National Forests in southern Idaho continued in 1971. A decrease in tree killing occurred on the Boise National Forest, and populations stabilized on the Payette and Salmon National Forests. Increased mortality was observed in the South Fork of the Boise River, Sawtooth National Forest.

Increasing populations of the Engelmann spruce beetle caused extensive tree mortality in central Utah in 1971. The most damaging infestation was on the Manti-LaSal National Forest. Other outbreaks were on the Fishlake and Uinta National Forests.

A persistent outbreak of the roundheaded pine beetle in ponderosa pine on the Las Vegas Ranger District, Toiyabe National Forest, continued in 1971, but at a lower level than in previous years.

The most notable defoliator throughout Region 4 was the western spruce budworm. Two major infestation centers in the Region were on the Payette and Boise National Forests in southwestern Idaho and on the Bridger, Targhee, and Teton National Forests in southeastern Idaho and western Wyoming. Heavy defoliation is predicted for both infestation centers. The infestation on the Ashley National Forest has subsided.

Other forest and range insect infestations are discussed.

PATHOLOGY

Five new *Fomes annosus* root rot infection centers were found or reported during 1971. Losses ranged from negligible to severe.

In 1971, overstory removal and understory sanitation thinning were conducted over 360 acres for dwarf mistletoe control. Twelve biological evaluations of candidate areas for treatment in fiscal year 1973 were completed and three are pending. Technical assistance was again provided to the State of Idaho on a timber sale conducted for dwarf mistletoe control purposes.

Analyses of sulfation plate sampling background levels of SO_2 in the Glen Canyon National Recreation Area and vicinity revealed essentially non-detectable levels at present. A very sensitive test by the University of Utah confirmed the results from the sulfation plates. A series of permanent examination plots were established in the Glen Canyon National Recreation Area.

Forest disease evaluations of a number of Land Use Study Areas were completed this year.

ENTOMOLOGY

Bark Beetles

Mountain pine beetle, *Dendroctonus ponderosae* Hopkins

Lodgepole pine

The massive mountain pine beetle infestations that occurred during the 1960's in the lodgepole pine forests of Idaho and Wyoming subsided again in 1971. Tree killing continued over extensive areas on the Targhee, Teton, Bridger, and Caribou National Forests and in Grand Teton National Park, but at a lower level than in 1970. Apparently, the main

factor causing infestations to subside was the depletion of suitable host trees. The only increases in tree killing occurred in portions of the Targhee and Teton National Forests and in Grand Teton National Park.

The most extensive and damaging infestation in the Region in 1971 was on the Targhee National Forest. Overall, the outbreak has been decreasing since 1969, when the peak level of mortality occurred. Nevertheless, a buildup occured at the northeastern end of the Forest where sufficient susceptible trees remained. Elsewhere, tree killing decreased. A decreasing trend in mortality will continue Forestwide in 1972.

In the Warm River area at the northeastern end of the Targhee National Forest, beetle populations have increased for the past 2 years. Control programs were undertaken from 1967 through the spring of 1970 in this area, but those efforts only slowed the rate of mortality. Rampant infestations to the south along the West Slope of the Teton Mountain Range on the Forest and to the east in Yellowstone National Park, along with localized buildups from within the control area, sustained the outbreak during control years. In 1970, once suppression was stopped, large increases developed throughout the entire area. A fall 1971 on-the-ground reconnaissance showed a significant increase in the number of trees killed, and considerable reductions in merchantable timber volume were recorded in some areas. The outbreak is expected to increase again in 1972 and further decimate the stands.

The infestation moved into uninfested stands in the north and has now reached the Moose Creek Plateau. The damage will increase in 1972. Chemical or other suppression measures were not considered because of the overwhelming pressure from the uncontained beetle populations to the south in the Warm River area and to the east in Yellowstone National Park. Accelerated logging to harvest as much of the threatened timber as possible was recommended.

Scattered tree killing continued on the Ashton Ranger District south of the Cave Falls road and on the Teton Basin and Palisades Ranger Districts at the southern end of the Targhee National Forest. These once huge infestations have run their course and were at a low level. Further decreases are expected in 1972.

In Grand Teton National Park, a general decline in tree killing took place in 1971. The infestation has subsided in most areas of the Park, except at the northern end where an increase occurred. Chemical control programs were conducted from 1957 to 1967 in the Park and on the neighboring Teton National Forest to suppress the infestations; however, conditions favorable to the insect were not changed, and a large increase in tree killing resulted after termination of suppression efforts. The outbreak reached a peak level in 1969, leveled off in 1970, and decreased in 1971. Another decrease is forecast for 1972.

Few stands in the Region have incurred heavier losses than those near Arizona Lake in Grand Teton National Park. However, a stand structure cruise conducted over 320 acres west of the lake showed that the extent of the mortality was not as severe as it appeared. The results of the survey revealed that 45 percent of the host type and 37 percent of the total stand were killed. In terms of volume, 52 percent of the host type and 45 percent of the entire stand were lost. The stand contained 5,620 board feet of lodgepole pine, 1,880 board feet of other tree species, for a total live volume of 7,500 board feet per acre. Approximately 64 trees per acre above 5 inches in diameter were killed. Mortality of trees 5 inches and below, although not recorded, was negligible.

On the Teton National Forest, aerial survey data showed that the only active infestation center in 1971 was adjacent to the outbreak at the northern end of Grand Teton National Park. The unrestrained outbreak in nearby Yellowstone National Park may have provided some impetus to this localized buildup. Widely scattered mortality was observed in other areas of the Forest, but the infestation is rapidly declining. Predictions for 1972 indicate that an increase will occur at the northwestern end of the Forest near and within the Teton Wilderness, but the infestation will decrease in other areas.

The infestations on both Divisions of the Bridger National Forest reached a peak in 1970 and decreased in 1971. On the Bridger Division (eastern segment), concentrations of currently faded trees were observed

Ektachrome infrared aerial photograph of lodgepole pine killed by the mountain pine beetle near Arizona Lake, Grand Teton National Park. Snags (dead trees) are turquoise in color, live green trees appear red, and current "faders" are yellow.

from New Fork Lakes at the northwestern end of the Division down the southern front of the Wind River Mountain Range to Big Sandy Creek at the southeastern end. Lodgepole pine occurs in a narrow strip down the front and most stands have been depleted to some degree. A decreasing trend is predicted for most areas in 1972.

The once huge infestation on the Caribou National Forest decreased in 1971. Control was not undertaken on this Forest and the infestation has progressed in a natural manner. Once again, the single-most limiting factor was the eventual depletion of susceptible trees.

Widely scattered lodgepole pine mortality occurred on parts of the Sawtooth and Cache National Forests in Idaho and Utah and the Ashley and Wasatch National Forests in Utah. Local buildups could occur on these Forests, but overall losses should be minimal.

The Effects of Mountain Pine Beetle Infestations

In many areas on the Targhee, Bridger, Teton, and Caribou National Forests, land managers are now faced with the formidable task of managing the depleted forests, especially in low elevation stands where damage is often most severe. Low timber volumes, increased maintenance costs of roads and trails, and the loss of many large trees in recreation sites may be some of the more tangible resource values detrimentally affected. Other less tangible, but important, factors, such as increased fire hazard, restriction of wildlife movement, and possibly esthetics, may also have a negative impact.

Conversely, there are many stands which have not been seriously depleted during outbreaks. Stand cruises have shown that anywhere from 10 to 45 percent of the stems per acre above 5 inches in diameter are killed. In many areas, sufficient volumes of merchantable timber remain and harvesting operations can continue. Further, the results of some outbreaks may be considered beneficial in many respects. The results of 34 studies[1], five of which were conducted in the Rocky Mountain area, showed that a reduction

1 Hibbert, A.R. 1967. Forest treatment effects on water yield. Proceedings International symposium on Forest Hydrology held at Pennsylvania State University, August 29 - September 10, 1965: 527. Pergamon Press.

in forest cover increased the total amount of water yield. Hibbert stated, "A practical upper limit of yield increase appears to be about 4.5 mm per year for each percent reduction in forest cover, but most treatments produced less than half this amount." Range and wildlife habitat also may be improved because of reduction in forest cover and subsequent increases in understory vegetation[1]. An excessive reduction of stands over extensive areas would be detrimental to wildlife, but this pattern of mortality does not occur. Additionally, the mountain pine beetle serves a function in the forest community by removing the larger trees and permitting nutrients to be recirculated to younger, more vigorous trees. The loss of the larger trees in an area managed primarily for timber production would be detrimental, but it would be a benefit in areas managed to preserve a natural environment, such as in Wilderness areas, National Parks, etc. In any event, the net impact of the mountain pine beetle in our depleted lodgepole forests is still unknown. Hopefully, a preliminary impact survey, which is in progress now, will provide some insight into this neglected area.

Ponderosa pine

Widely scattered infestations of the mountain pine beetle in ponderosa pine continued in several areas in Utah and Idaho in 1971. This beetle apparently prefers stagnated and weakened trees when attacking this host. Sartwell (1971)[2] documented this general trend in portions of Oregon and Washington. Excessive between-tree competition generally predisposes pole-size stands to beetle depredations. Larger diameter trees on poor sites are subject to attack because they are in a weakened state.

In southern Utah, an outbreak on the Dixie National Forest and adjoining Bryce Canyon National Park has caused scattered tree mortality since 1966. The peak level in tree killing occurred in 1969 and the infestation has decreased since then. Two stand cruises conducted in the Park in 1971 showed that about eight percent of the ponderosa pine had been killed in one area and 13 percent in another. Pole-size trees were killed in clumps and larger trees were killed singly or in small groups. The infestation is expected to decrease further in 1972.

Ponderosa pine killed by the mountain pine beetle, Bryce Canyon National Park.

On the Ashley National Forest in northern Utah, an outbreak in both ponderosa pine and lodgepole pine decreased near Greendale Junction in the northeast section of the Forest, but an increase was detected west of the Sheep Creek Canyon Geological Area. The beetle populations have fluctuated in both of

1 Personal communication. February 17, 1972. Floyd C. Noel, U.S. Forest Service, Division of Wildlife Management, Ogden, Utah.

2 Sartwell, Charles. 1971. Thinning of Ponderosa Pine to Prevent Outbreaks of Mountain Pine Beetle. Reprint from the proceedings of the short course on Precommercial Thinning of Coastal and Intermountain Forests in the Pacific Northwest, held February 2 and 4, 1971, at Washington State University in Pullman, Washington: 45-51.

these areas for the past several years and will continue to do so in 1972. A decreasing trend was predicted for the infestation center near the Sheep Creek Canyon Geological Area and an increase should occur near Greendale Junction.

A persistent infestation in stagnated, second-growth ponderosa stands on private lands near Cascade, Idaho, continued for the eighth consecutive year. It will remain at about the same level in 1972. Elsewhere, widely scattered mortality occurred on the Boise, Payette, Challis, Sawtooth, and Salmon National Forests. The western pine beetle, *Dendroctonus bevicomis* LeConte, was also responsible for causing some tree mortality in association with the mountain pine beetle.

Limber and Whitebark pines

Extensive mortality of limber and whitebark pines has been mapped during aerial surveys for the past two years. Tree killing has occurred at high elevation sites near intense mountain pine beetle infestations in lodgepole pine on the Targhee, Teton, and Bridger National Forests and Grand Teton National Park. The survey data strongly indicated that the insects have moved from infestations in lodgepole pine at lower elevations to limber and whitebark pines at higher elevations. Additional losses are expected in 1972.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins

The trend of Douglas-fir beetle infestations in southwestern Idaho varied from a decreasing situation on the Boise National Forest to an increasing condition on the Sawtooth National Forest. In 1971, the major portion of the Douglas-fir mortality occurred on the Boise, Payette, Salmon and Sawtooth National Forests. Lesser amounts of mortality occurred on the Targhee National Forest in southeastern Idaho and on the Bridger National Forest in Wyoming.

Overall, the infestations on the Boise and Payette National Forests are expected to decline in 1972. A reduction in storm-damaged Douglas-fir trees over the past few years precluded further insect population increases. On the Boise National Forest, there were no extensive areas of Douglas-fir mortality. Rather, scattered groups of trees were recorded during aerial surveys. Even though local losses were not significant, the Forest-wide loss was sizeable. In contrast, heavy mortality occurred along the South Fork of the Salmon River on the Warren Ranger District, Payette National Forest. As many as 500 trees were killed in some groups. Elsewhere, losses were scattered.

A significant decline in mortality occurred in portions of Hat and Iron Creeks on the Salmon National Forest. Sozeable groups of "faders" occurred for another year near Long Tom Mountain on the Indianola Ranger District. Widely scattered tree killing took place in other areas of the Forest.

The infestation on the Sawtooth National Forest along the South Fork of the Boise River increased in 1971. The major increases were near Crouch Summit on the Fairfield Ranger District and around the Shake Creek Ranger Station.

Scattered infestations continued on the Palisades Ranger District on the Targhee National Forest and along the Grand Canyon of the Snake River, Bridger National Forest.

Engelmann spruce beetle, *Dendroctonus rufipennis* (Kirby)

Building spruce beetle populations caused extensive Engelmann spruce mortality in central Utah in 1971. Significant tree killing occurred in high elevation stands on the Manti-LaSal (Manti Division), Fishlake, and Uinta National Forests. Higher levels of damage are expected on portions of these Forests in 1972.

The most damaging infestation was on the Manti-LaSal National Forest. Due to the scattered nature of this infestation and the potential of the beetle population, control was not possible. Salvage logging was recommended.

A sizeable buildup in spruce mortality was detected in 1971 on the Beaver Ranger District of the Fishlake National Forest from Puffer Lake south to Anderson Meadow Reservoir. This infestation has been slowly building, but it has not reached a level comparable to the infestation on the Manti-LaSal National Forest. However, many merchantable spruce stands are threatened. The outbreak on Hilgard Mountain on the Loa Ranger District continued.

Scattered tree killing has occurred in the upper reaches of the Race Track Creek, Uinta National Forest, since 1968 or before. In 1971, a chemical control program, using ethylene dibromide, was undertaken to suppress the beetle population in a logging area. Early winter storms prevented the program from being completed, but treatment will continue in the spring of 1972, before the beetle flight.

Roundheaded pine beetle, ***Dendroctonus adjunctus*** **Blandford**

The persistent outbreak of the roundheaded pine beetle on the Las Vegas Ranger District, Toiyabe National Forest, continued in 1971. However, aerial survey records indicated that a reduction in the level of killing of mature and overmature ponderosa pine occurred. Some tree mortality will continue in 1972 in the summer home area in Kyle Canyon and in nearby recreation sites, but at a lower level than previous years. Overall losses on the District will be minimal.

Defoliators

Western spruce budworm, ***Choristoneura occidentalis*** **Freeman**

The western spruce budworm continued to defoliate Douglas-fir and true fir stands in two major infestation areas in the Intermountain Region during 1971. The largest and most destructive outbreak occurred in central and southern Idaho, and the other in western Wyoming.

The acreage of trees defoliated by the western spruce budworm in recent years has remained far below the peak level of 1964, when over two million acres were infested. Following is a chronology of infested area in the Intermountain Region by defoliation level, as determined during aerial surveys:

DEFOLIATION INTENSITY (ACRES)

Year	Light	Moderate	Heavy	Total
1960	297,000	80,000	19,000	396,000
1961	643,000	229,000	553,000	1,425,000
1962	480,000	373,000	788,000	1,641,000
1963	357,800	276,600	988,800	1,623,200
1964	266,000	658,000	1,352,000	2,276,000
1965	465,600	254,500	795,200	1,515,300
1966	923,900	52,200	16,100	992,200
1967	162,200	54,900	1,600	218,700
1968	333,500	150,200	21,800	505,500
1969	388,800	125,400	30,200	544,400
1970	223,200	79,300	5,200	307,700
1971	229,300	110,300	34,300	373,900

Defoliation intensity increased on the Payette, Bridger, Targhee, and Teton National Forests. In localized areas, heaviest damage was in the form of top and branch killing. With the exception of the Payette and Boise National Forests, there was a decrease in the number of infested acres.

The small infestation on the Caribou National Forest remained unchanged and is at a low level. No defoliation was recorded during aerial surveys on the Challis, Salmon, and Sawtooth National Forests; and for the first time since 1967, no budworm activity was detected on the Ashley National Forest.

A breakdown of budworm defoliation by Forest in 1971 follows:

Based on egg mass data, western spruce budworm populations and subsequent defoliation will increase in 1972 on the Payette, Bridger, and Teton National Forests. If these heavy populations materialize, particularly in some areas on the Bridger National Forest, some mortality of the suppressed understory may occur. Otherwise, permanent damage to the established overstory will be negligible. Control is not planned.

Western Spruce Budworm Impact Data

For over 20 years, infestations of the western spruce budworm have been recorded in the Douglas-fir and true fir forests in the Intermountain Region, during which time considerable time and money have been expended to control these infestations. However, adequate stand impact information is lacking, and it is these data that are needed to properly weigh the basic premise upon which all management decisions should be based. Simply stated, that premise is "What degree of damage can be tolerated before management objectives are affected to a point that control expenditures are justified?"

At present, little information is available on the impact of budworm defoliation on Douglas-fir and true fir stands in the Intermountain Region in terms of mortality (tree, top, and branch), growth loss (radial and terminal), and other resource values. Preliminary impact data were collected during 1971 on which to form a basis for improving and developing sampling techniques. A cursory analysis of these data indicate impact of budworm defoliation on tree mortality and growth is not nearly as high as once thought. Additional data collections are planned for 1972.

DEFOLIATION INTENSITY (ACRES)

Forest	Light	Moderate	Heavy	Total	Trend[a/]
Ashley	—	—	—	—	Decreased
Boise	12,400	4,800	—	17,200	Increased
Bridger	9,000	7,600	8,600	25,200	Decreased
Caribou	100	—	—	100	Static
Payette	203,300	88,900	24,000	316,200	Increased
Targhee	3,700	6,000	100	9,800	Decreased
Teton	800	3,000	1,600	5,400	Decreased
Total	**229,300**	**110,300**	**34,300**	**373,900**	**Increased**

[a/] Trend determined by relative change in infested acreage from 1970 to 1971.

A leaf blotch miner, *Lithocolletis* sp., near *salicivorella* Braun

For several years, this leaf blotch miner has caused varying degrees of damage to Fremont cottonwood in Zion National Park. There was heavy defoliation in 1969 and moderate damage in 1970. For reasons unknown, the population dropped to a very low level in 1971 and defoliation went virtually unnoticed.

A looper, *Lambdina punctata* (Hulst)

The once damaging infestation on gambel oak along the Wasatch Front in Utah during the late 1960's subsided in 1970. No damage was recorded in 1971.

Sugar pine tortrix, *Choristoneura lambertiana* (Busck)

For the first time in several years, defoliation of lodgepole pine by this pest was not detected during aerial surveys.

A leaf roller, *Archips negundanus* (Dyar)

For three years this insect has caused heavy defoliation of box elder trees in several areas in northern Utah. Although almost complete defoliation occurs, trees refoliate by mid-summer with no apparent adverse effect. The outlook for 1972 is for continued heavy defoliation.

A tent caterpillar, *Malacosma incurvum discoloratum* (Neumoegen)

Tent caterpillar populations on Fremont cottonwood in Zion National Park were at their lowest level in many years. Outside the Park, however, light to moderate defoliation occurred along the Virgin River west to Hurricane, Utah.

Pine butterfly, *Neophasia menapia* (Felder & Felder)

Even though spectacular flights of pine butterflies have been observed for the past three years on the Boise and Payette National Forests, only light defoliation was reported in scattered area on the Payette National Forest. Control is not planned.

A pine butterfly, Neophasia menapia (Felder & Felder).

A sawfly, *Neodiprion fulviceps* (Cresson)

Defoliation intensified in a small stand of ponderosa pine near the head of Clear Creek on the Fishlake National Forest. Although the larval population was reduced by what may have been a bacterial disease, defoliation was heavy to severe. The effect of this obscure disease on the population of this sawfly is unknown.

Sawfly larvae, Neodiprion fulviceps (Cresson).

White fir needle miner, *Epinotia meritana* (Heinrich)

The infestation on white fir in the East Fork of the Sevier River, Dixie National Forest, increased slightly during 1971. Many of the most heavily defoliated trees are in a seriously weakened state.

Western tussock moth, *Orgyia vetusta gulosa* (Hy. Edwards)

Heavy defoliation of a *Ceanothus* sp. continued in the Town Creek Plantation, Boise National Forest. In several areas, the *Ceanothus* sp. was severely defoliated and tussock moth larvae moved to young ponderosa pine and caused light to moderate defoliation. No pine mortality was observed.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* (McDunnough)

Mature Douglas-fir stands on State, private, and BLM lands in Owyhee County, Idaho, incurred heavy defoliation in 1971. Heavy larval mortality caused by a native polyhedrosis virus severely reduced the population. Indications point to only light defoliation during 1972.

An incense cedar leaf miner, *Argyresthia* sp., new sp.

The general decline of incense cedar trees along the southeast side of Lake Tahoe, Nevada, was once thought to be caused by this defoliator. Subsequent observations during 1971 disclosed trees in a state of decline with or without leaf miner damage. Present indications are that this insect is only a secondary problem. Leaf miner defoliation decreased during 1971 and will remain at a low level in 1972.

A needle miner, possibly *Zelleria hambachi* Busck

Damage by this insect was first reported to Regional entomologists in 1971. Light to moderate defoliation of pole-size and understory ponderosa pine was observed in Bull Canyon and near South Peak on the Manti-LaSal National Forest. Young larvae enter the needle fascicle and kill the needle before it is full grown. The future status of this outbreak is unknown.

PATHOLOGY

Root Rots

At least 15 separate *Fomes annosus* root rot centers were diagnosed in a seed orchard of genetically selected ponderosa pine seedlings planted in a ponderosa pine clearcut near Idaho City, Boise National Forest. Losses ranged from one to four seedlings per infection center. Logging was conducted in the early 1960's, seedlings were planted in 1966, and excessive mortality was first noted in the spring of 1970. Mortality is expected to continue, since the root systems of the felled trees are quite extensive. A large *Fomes annosus* root rot center was found on the Indian Creek Trail in the Idaho Primitive Area. Twenty-three ponderosa pines from one to five inches d.b.h. and two trees over 30 inches d.b.h. were killed. Mortality will continue. The infection probably became established when the trail was constructed.

Dying of true fir in the Albion Basin Area on the Alta Ski Resort was investigated. The first five groups of fir examined were all found to be infected by *Fomes annosus.* It was felt that no further sampling was necessary. This area has a history of mining that goes back to 1864 and continued until the end of the Depression. Firewood and pit props were cut throughout Little Cottonwood Canyon and Albion Basin for as long as there was active mining in the district. Stumps created by such cutting are undoubtedly the infection court.

Pathologists from the Forestry Sciences Laboratory at Logan, Utah, reported finding two *Fomes annosus* centers. One was in Spring Creek, Indianola and Salmon Ranger Districts, Salmon National Forest, killing ponderosa pine reproduction. The other center was found 10 miles east of Lowman, Idaho, on the South Fork of the Payette River, Payette National Forest, where ponderosa pine seedlings were killed. A *Fomes annosus* conk also was found on a dead bitterbrush plant in the infection center, but no attempt was made to isolate the fungus from the dead tissue.

Dwarf mistletoe

Overstory removal and understory sanitation thinning were accomplished on 360 acres in 1971 for dwarf mistletoe control. Most overstory was removed by felling. In one area, the overstory was girdled. Some of these dead trees were sold as house logs; the rest sold for firewood. For fiscal year 1973, there are 15 proposals for dwarf mistletoe control projects. Twelve biological evaluations of candidate areas were completed; three are pending. Technical assistance was provided to the State of Idaho, Department of Public Lands, on a timber sale conducted for dwarf mistletoe control. Dwarf mistletoe-infected trees were selected for removal when marking for cutting. Followup timber stand improvement crews girdled infected nonmerchantable trees which were jeopardizing uninfected regeneration.

Air Pollution

Sulfation plate analyses were taken from May to December 1971 from 14 stations on the Glen Canyon

National Recreation Area and adjoining BLM lands to the north. Concentrations of SO_2 were too low to be detected by the plates. Similar results were obtained from plates exposed by the Utah Public Health Service. A very sensitive test conducted by the University of Utah, using a manual modified West-Gaeke procedure revealed SO_2 levels to be about 0.002 ppm. This level is generally considered as natural background. Sampling will be terminated when one year of data is accumulated. Sampling will resume when the Navajo plant begins operation. In the spring of 1971, a series of seven vegetation examination plots were located on the Glen Canyon NRA and BLM lands to the north. Spring and fall examinations are scheduled on these plots until the effects of SO_2 emissions from the Navajo plant can be defined. A photo album of close color photographs of representative vegetation will be kept for comparison purposes.

Land Use Studies

This year, as part of the Regional Land Use Study Program, forest diseases in the Idaho Primitive Area, Upper South Fork of the Boise River-Smoky Mountains, and West Slopes of the Tetons were reevaluated. In all areas, the most serious disease problem was dwarf mistletoe.

DISTRIBUTION OF MAJOR FOREST INSECT INFESTATIONS IN REGION 4

1971

LEGEND

- *Mountain Pine Beetle*
- *Douglas-fir Beetle*
- *Western Budworm*
- *Engelmann Spruce Beetle*

Based on aerial and ground surveys

DIVISION OF TIMBER MANAGEMENT

FOREST SERVICE

U. S. DEPARTMENT OF AGRICULTURE

SCALE *miles* 0 40

PAYETTE NATIONAL FOREST
SALMON NATIONAL FOREST
CHALLIS NATIONAL FOREST
BOISE NATIONAL FOREST
SAWTOOTH NATIONAL FOREST
TARGHEE NATIONAL FOREST
CARIBOU NATIONAL FOREST
BRIDGER NATIONAL FOREST
HUMBOLDT NATIONAL FOREST
WASATCH NATIONAL FOREST
UINTA NATIONAL FOREST
ASHLEY NATIONAL FOREST
MANTI-LA SAL NATIONAL FOREST
DIXIE NATIONAL FOREST
TOIYABE NATIONAL FOREST
CACHE NATIONAL FOREST
FISHLAKE NATIONAL FOREST
GRAND TETON NATIONAL PARK
YELLOWSTONE NATIONAL PARK
CAPITOL REEF NATIONAL MONUMENT
BRYCE CANYON NATIONAL PARK
ZION NATIONAL PARK
CEDAR BREAKS NATIONAL MONUMENT
CURLEW NATIONAL GRASSLAND

McCall, Cascade Reservoir, Challis, Boise, St. Anthony, Jackson, Jackson Lake, Yellowstone Lake, Pocatello, American Falls Reservoir, Twin Falls, Salmon, Pinedale, Kemmerer, Bear Lake, Logan, Ogden, Great Salt Lake, Salt Lake City, Flaming Gorge Reservoir, Vernal, Price, Moab, Utah Lake, Elko, Austin, Ely, Tonopah, Reno, Carson City, Lake Tahoe, Pyramid Lake, Walker Lake, Las Vegas, Lake Mead, Lake Powell, Richfield, Cedar City

Snake River, Salmon River, Humboldt River, Green River, Colorado River

OREGON, IDAHO, NEVADA, MONTANA, WYOMING, UTAH, COLORADO, ARIZONA, CALIFORNIA

RELIEF MAP
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